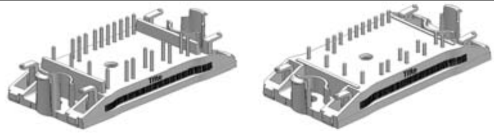
flowPACK 0 3rd gen — 600V/50A

Features

- 2 clip housing in 12mm and 17mm height
- Trench Fieldstop IGBT[3] technology
- Compact and low inductance design
- Built-in NTC

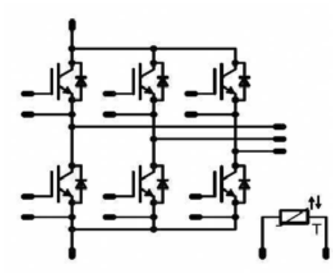
flow0 housing



Target Applications

- Motor Drives
- Power Generation
- UPS

Schematic



Types

- V23990-P865-F49-PM: 17mm height
- V23990-P865-F48-PM: 12mm height

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Transistor				
Collector-emitter voltage	V_{CE}		600	V
DC collector current	I_C	$T_j=T_{jmax}$ $T_h=80°C$ $T_c=80°C$	45	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by T_{jmax}	150	A
Power dissipation per IGBT	P_{tot}	$T_j=T_{jmax}$ $T_h=80°C$ $T_c=80°C$	76	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings*	t_{SC} V_{CC}	$T_j≤150°C$ $V_{GE}=15V$	6 360	µs V
Maximum Junction Temperature	T_{jmax}		175	°C

* It is recommended to not exceed 1000 short circuit situations in the lifetime of the module and to allow at least 1s between short circuits

Parameter	Symbol	Condition	Value	Unit
Inverter Diode				
Peak Repetitive Reverse Voltage	V_{RRM}	$T_j=25°C$	600	V
DC forward current	I_F	$T_j=T_{jmax}$ $T_h=80°C$ $T_c=80°C$	41	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	100	A
Power dissipation per Diode	P_{tot}	$T_j=T_{jmax}$ $T_h=80°C$ $T_c=80°C$	57	W
Maximum Junction Temperature	T_{jmax}		175	°C
Thermal properties				
Storage temperature	T_{stg}		-40…..+125	°C
Operation junction temperature	T_{op}		-40…..+Tjmax-25	°C

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Insulation properties					
Insulation voltage	V_{is}	t=2s	DC voltage	4000	V
Creepage distance				min.12,7	mm
Clearance				min.12,7	mm

Characteristic Values

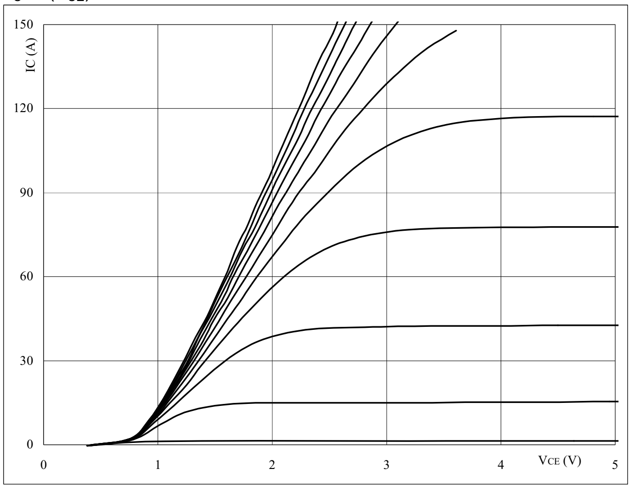
Parameter	Symbol	Conditions	V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Value Min	Value Typ	Value Max	Unit
Inverter Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0,0008	Tj=25°C Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		50	Tj=25°C Tj=150°C		1,51 1,75	2,1	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		Tj=25°C Tj=150°C			350	µA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			650	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgon=8Ω Rgoff=8Ω	±15	300	50	Tj=25°C Tj=150°C		95 100		ns
Rise time	t_r					Tj=25°C Tj=150°C		14 18		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		161 184		
Fall time	t_f					Tj=25°C Tj=150°C		109 131		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		0,68 1,02		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		1,30 1,76		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		3140		pF
Output capacitance	C_{oss}							200		
Reverse transfer capacitance	C_{rss}							93		
Gate charge	Q_{Gate}		±15	300	50	Tj=25°C		310		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK						1,25		K/W
Inverter Diode										
Diode forward voltage	V_F				50	Tj=25°C Tj=150°C		1,6 1,55	2,2	V
Peak reverse recovery current	I_{RRM}	Rgon=8Ω	±15	300	50	Tj=25°C Tj=150°C		51,6 62,4		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		130 172		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		2,29 4,37		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		3909 2375		A/µs
Reverse recovered energy	E_{rec}					Tj=150°C		0,92		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK						1,67		K/W
Thermistor										
Rated resistance	R_{25}	Tol. ±5%				Tj=25°C	20,9	22	23,1	kΩ
Deviation of R100	ΔR/R	R100=1486Ω				Tj=100°C		2,9		%/K
Power dissipation	P					Tj=25°C		210		mW
B-value	$B_{(25/100)}$	Tol. ±3%				Tj=25°C		4000		K

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$

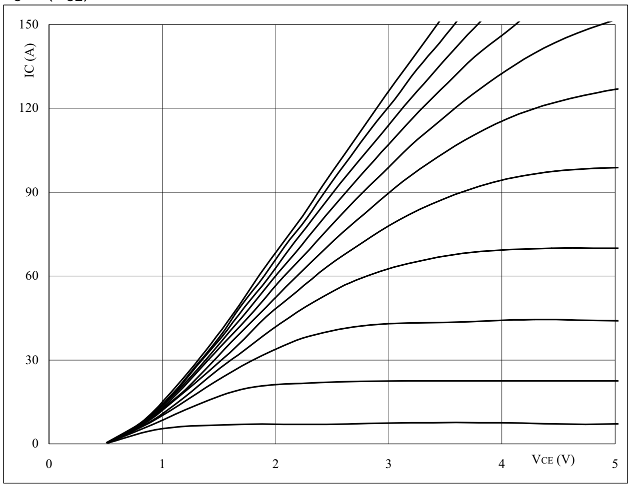


t_p = 250 µs
T_j = 25 °C
V_{GE} from 7 V to 17 V in steps of 1 V

Figure 2 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$

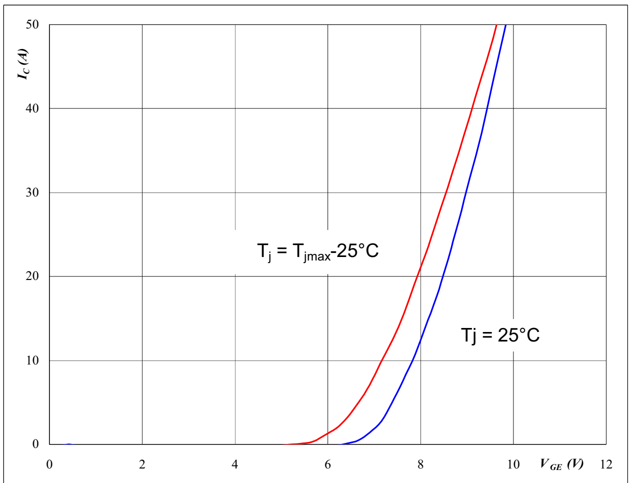


t_p = 250 µs
T_j = 150 °C
V_{GE} from 7 V to 17 V in steps of 1 V

Figure 3 Output inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

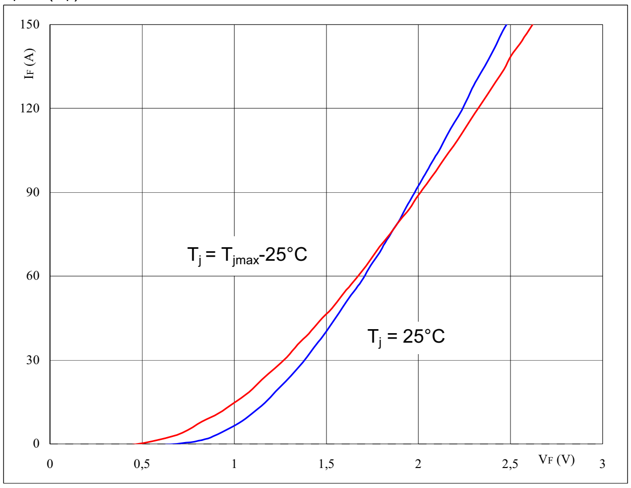


t_p = 250 µs
V_{CE} = 10 V

Figure 4 Output inverter FRED

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



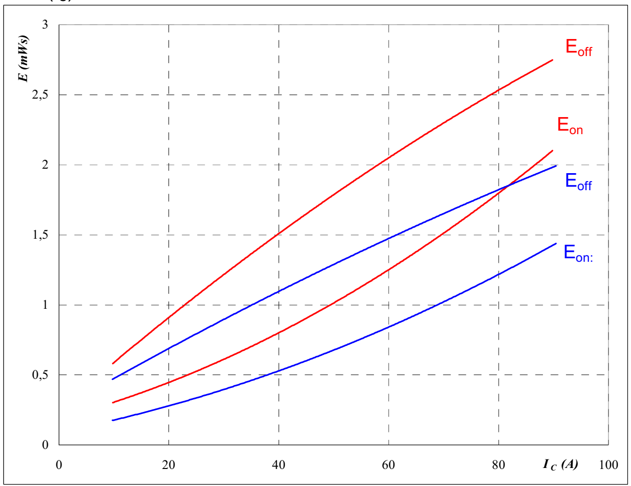
t_p = 250 µs

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses as a function of collector current

E = f(I_C)



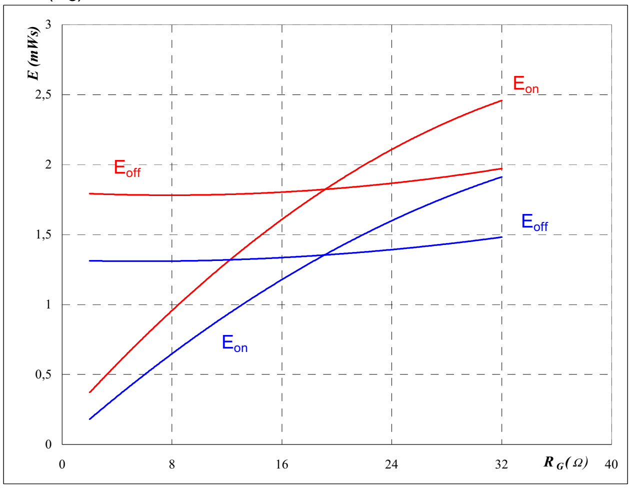
inductive load

T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

Figure 6 Output inverter IGBT

Typical switching energy losses as a function of gate resistor

E = f(R_G)



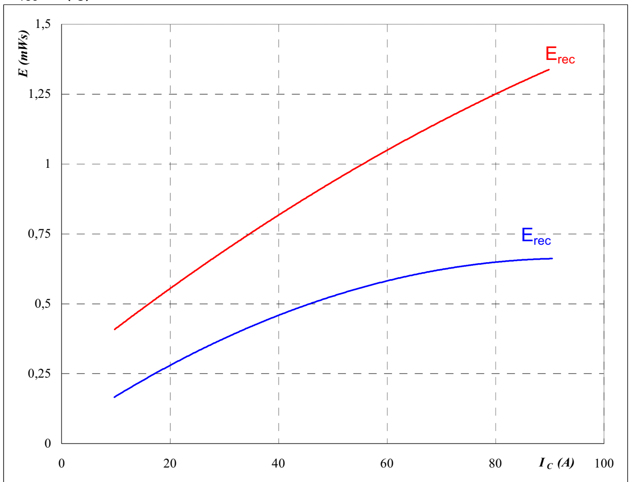
inductive load

T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	50	A

Figure 7 Output inverter IGBT

Typical reverse recovery energy loss as a function of collector current

E_{rec} = f(I_C)



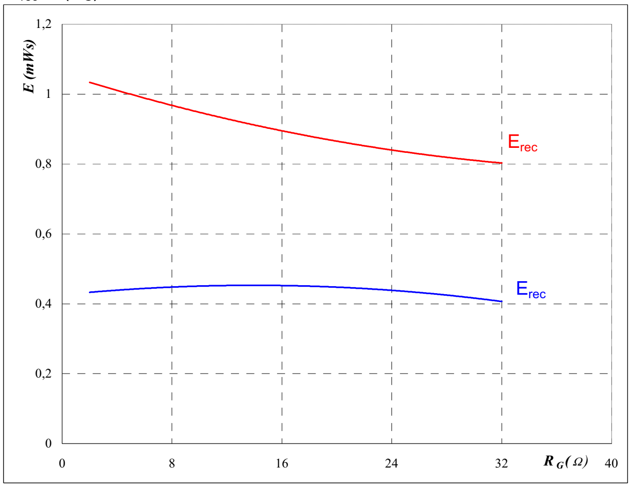
inductive load

T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 8 Output inverter IGBT

Typical reverse recovery energy loss as a function of gate resistor

E_{rec} = f(R_G)



inductive load

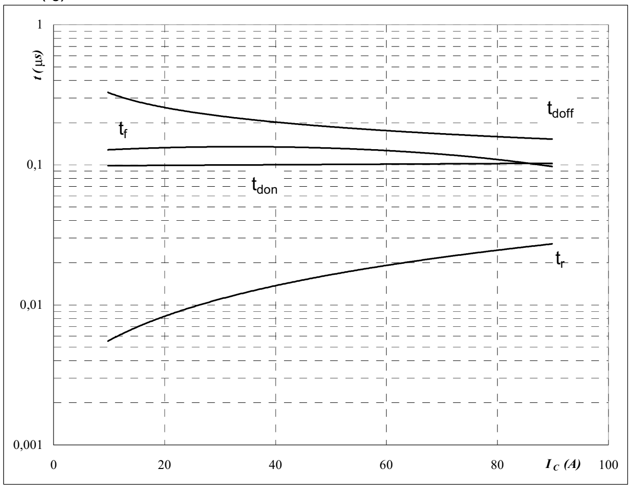
T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	50	A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



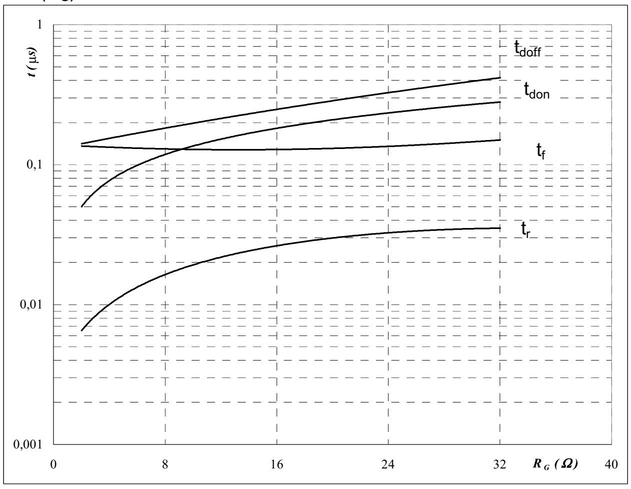
inductive load

T_j =	150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

Figure 10 Output inverter IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



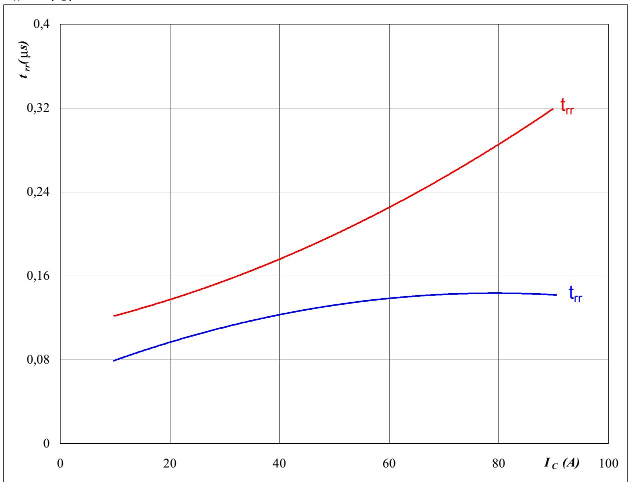
inductive load

T_j =	150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	50	A

Figure 11 Output inverter FRED

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

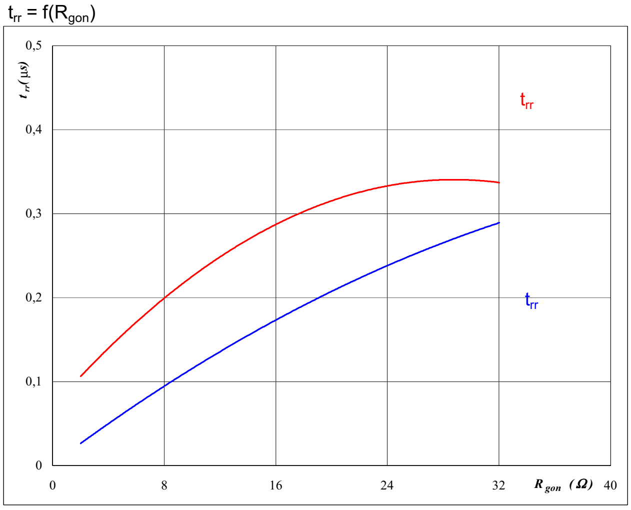


T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 12 Output inverter FRED

Typical reverse recovery time as a function of IGBT turn on gate resistor

$t_{rr} = f(R_{gon})$



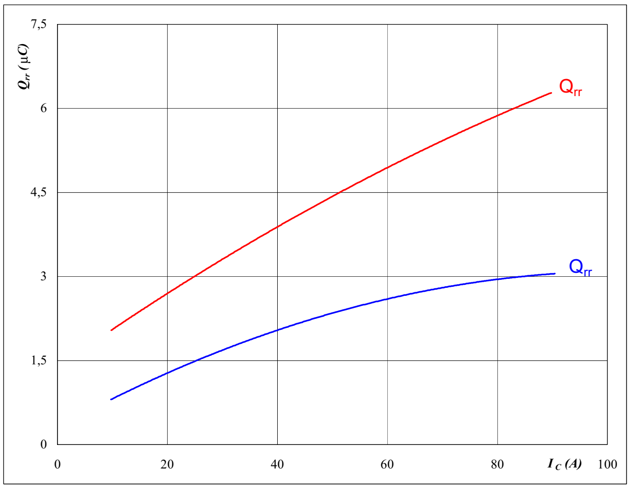
T_j =	25/150	°C
V_R =	300	V
I_F =	50	A
V_{GE} =	±15	V

Output Inverter

Figure 13 Output inverter FRED

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$

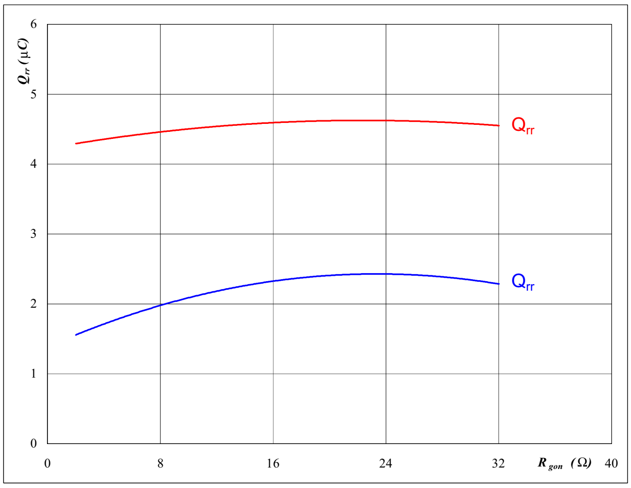


T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 14 Output inverter FRED

Typical reverse recovery charge as a function of IGBT turn on gate resistor

$Q_{rr} = f(R_{gon})$

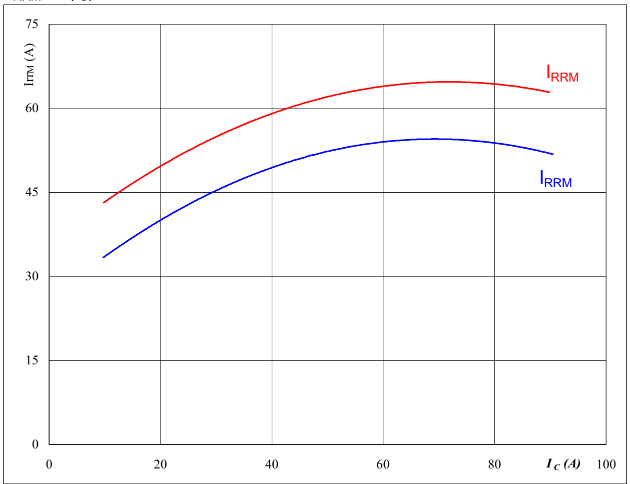


T_j =	25/150	°C
V_R =	300	V
I_F =	50	A
V_{GE} =	±15	V

Figure 15 Output inverter FRED

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$

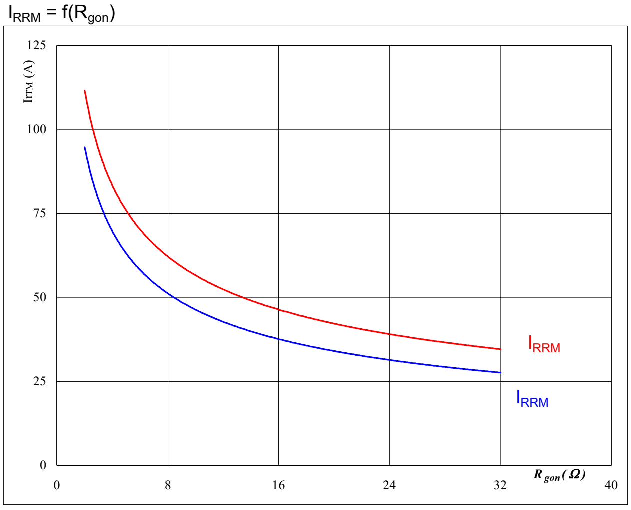


T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 16 Output inverter FRED

Typical reverse recovery current as a function of IGBT turn on gate resistor

$I_{RRM} = f(R_{gon})$



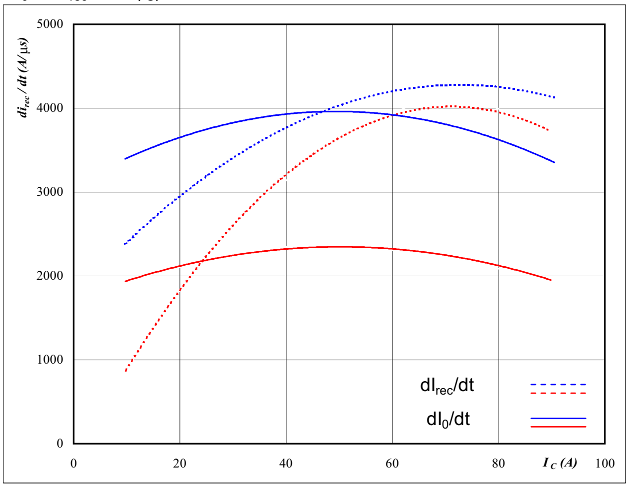
T_j =	25/150	°C
V_R =	300	V
I_F =	50	A
V_{GE} =	±15	V

Output Inverter

Figure 17 Output inverter FRED

Typical rate of fall of forward and reverse recovery current as a function of collector current

$dI_0/dt, dI_{rec}/dt = f(I_C)$

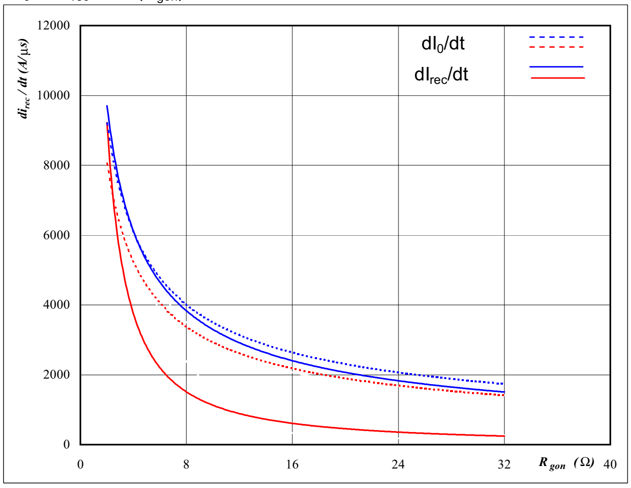


T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 18 Output inverter FRED

Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor

$dI_0/dt, dI_{rec}/dt = f(R_{gon})$

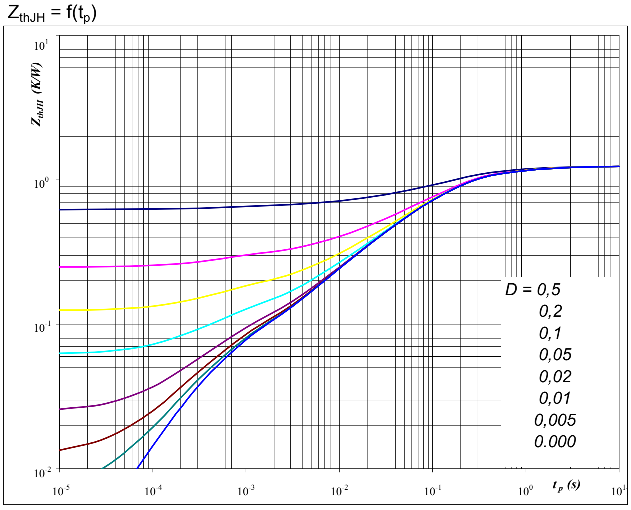


T_j =	25/150	°C
V_R =	300	V
I_F =	50	A
V_{GE} =	±15	V

Figure 19 Output inverter IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



D =	t_p / T	
R_{thJH} =	1,25	K/W

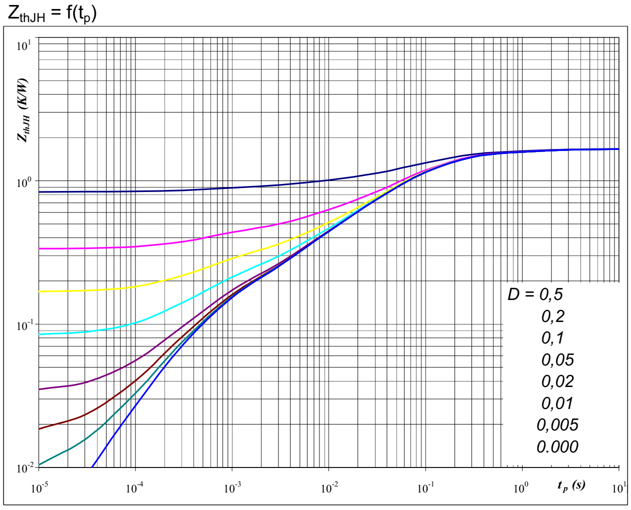
IGBT thermal model values

R (C/W)	Tau (s)
0,02	9,8E+00
0,16	1,1E+00
0,65	1,6E-01
0,26	3,3E-02
0,09	6,1E-03
0,06	4,5E-04

Figure 20 Output inverter FRED

FRED transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



D =	t_p / T	
R_{thJH} =	1,67	K/W

FRED thermal model values

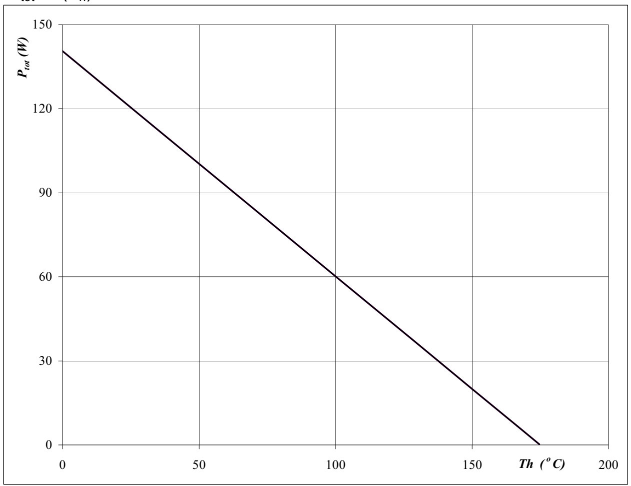
R (C/W)	Tau (s)
0,03	9,8E+00
0,16	9,9E-01
0,68	1,3E-01
0,50	3,7E-02
0,18	5,8E-03
0,12	5,1E-04

Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

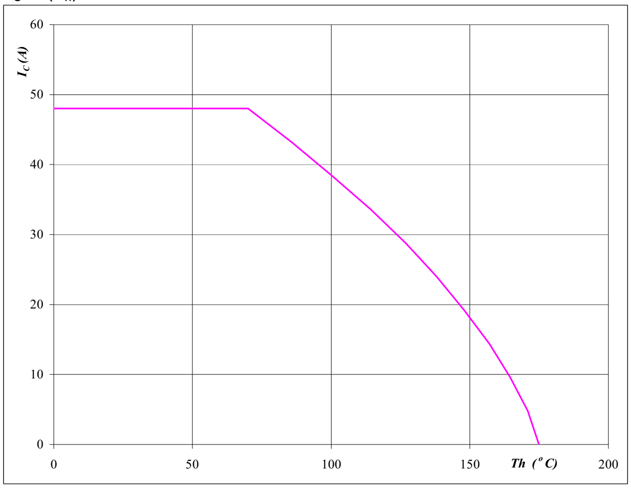


T_j = 175 °C

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



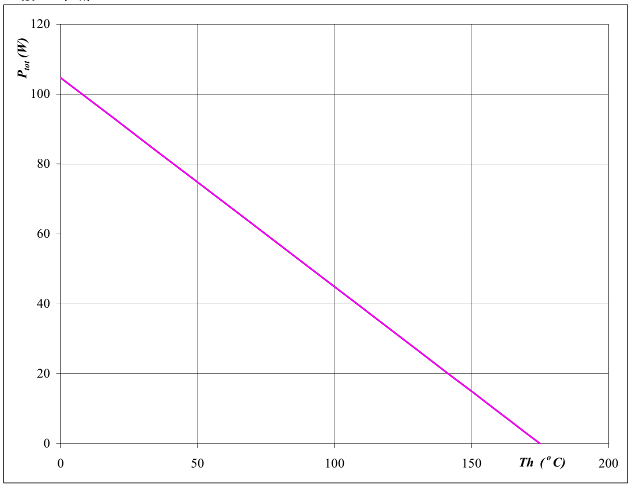
T_j = 175 °C

V_{GE} = 15 V

Figure 23 Output inverter FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

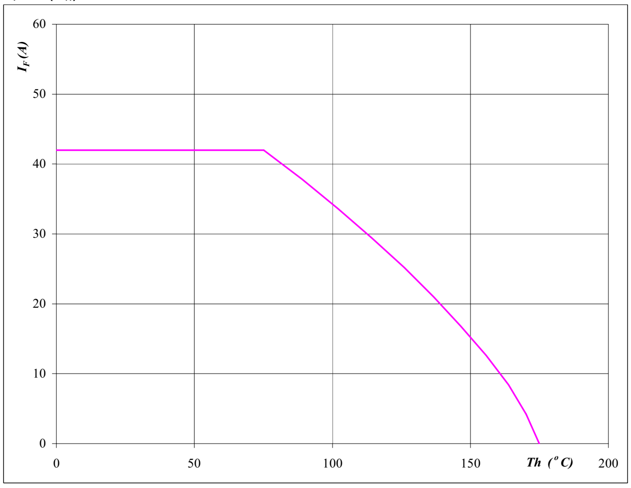


T_j = 175 °C

Figure 24 Output inverter FRED

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



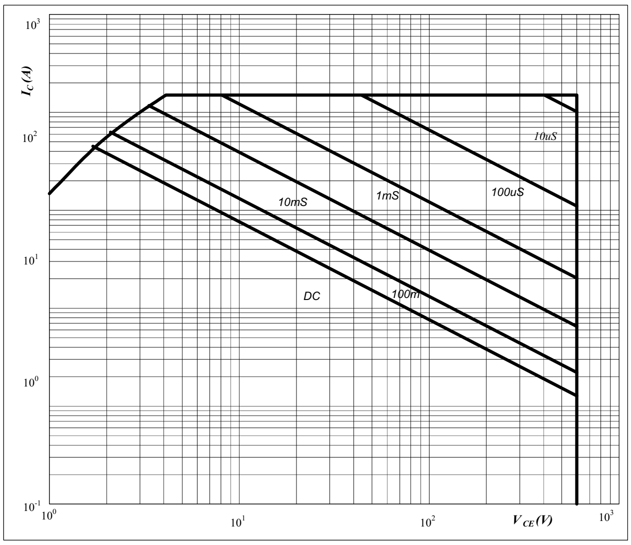
T_j = 175 °C

Output Inverter

Figure 25	Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$

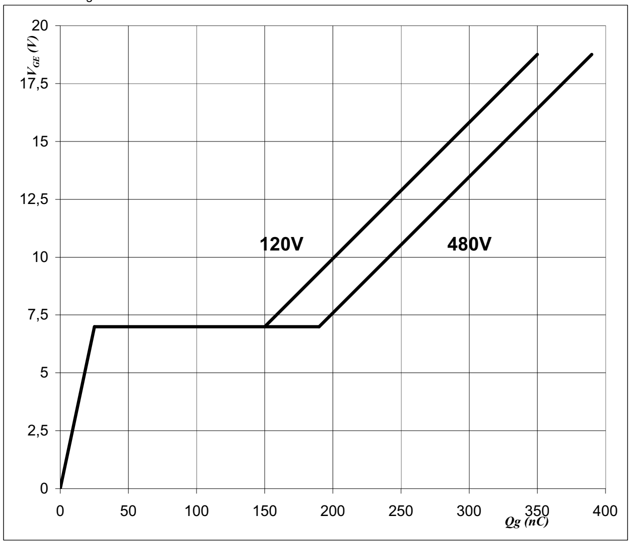


D =	single pulse	
T_h =	80	ºC
V_{GE} =	±15	V
Tj =	T_{jmax}	ºC

Figure 26	Output inverter IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



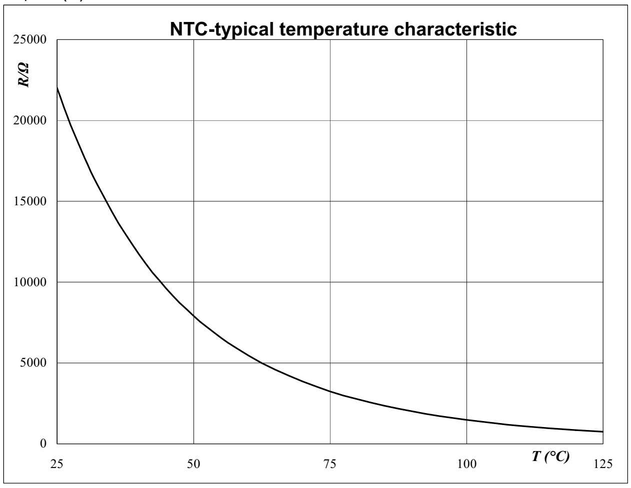
I_C =	50	A

Thermistor

Figure 1	Thermistor

Typical NTC characteristic as a function of temperature

$R_T = f(T)$



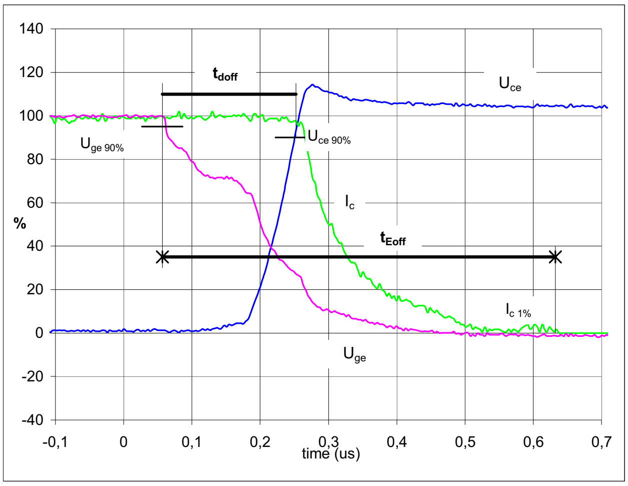
Switching Definitions Output Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	8 Ω
R_{goff}	=	8 Ω

Figure 1 Output inverter IGBT

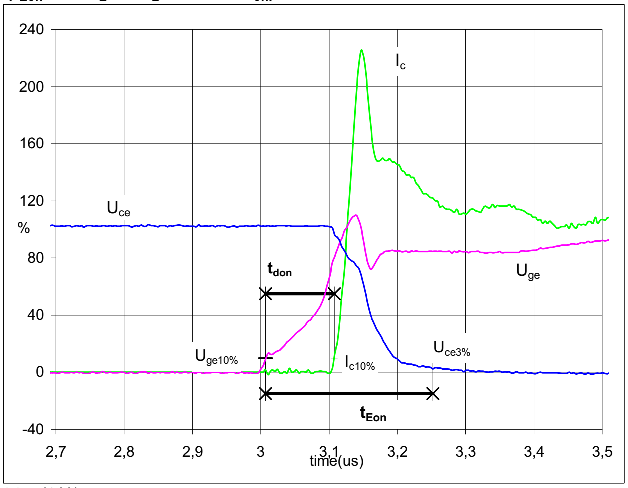
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	300	V
I_C (100%) =	50	A
t_{doff} =	0,18	µs
t_{Eoff} =	0,58	µs

Figure 2 Output inverter IGBT

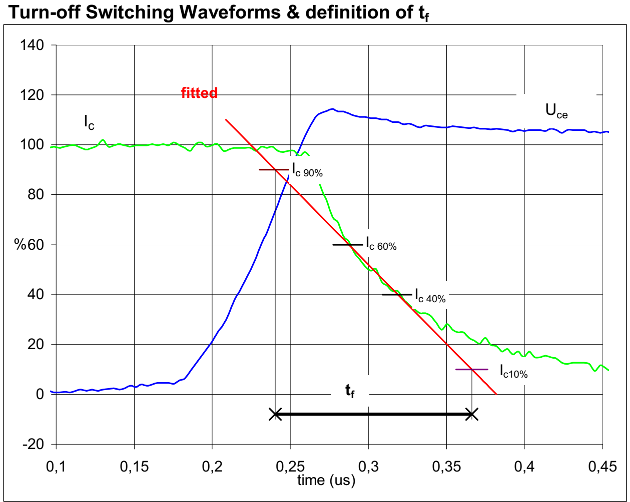
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	300	V
I_C (100%) =	50	A
t_{don} =	0,10	µs
t_{Eon} =	0,24	µs

Figure 3 Output inverter IGBT

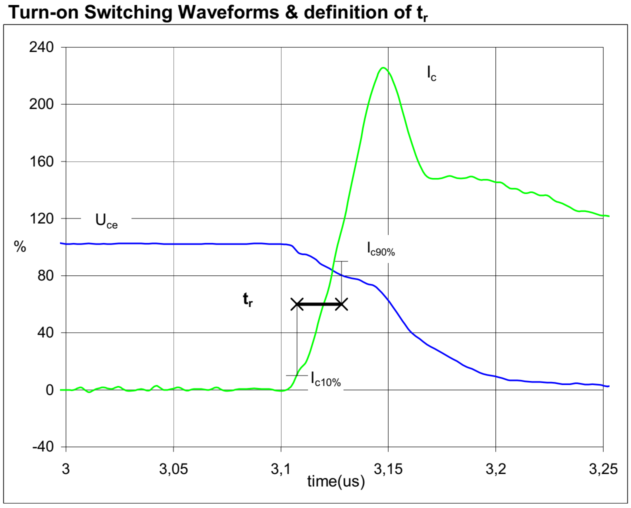
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	300	V
I_C (100%) =	50	A
t_f =	0,13	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

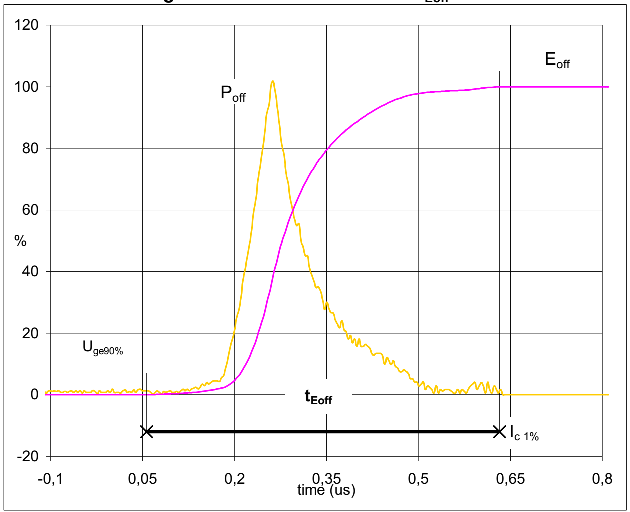


V_C (100%) =	300	V
I_C (100%) =	50	A
t_r =	0,02	µs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

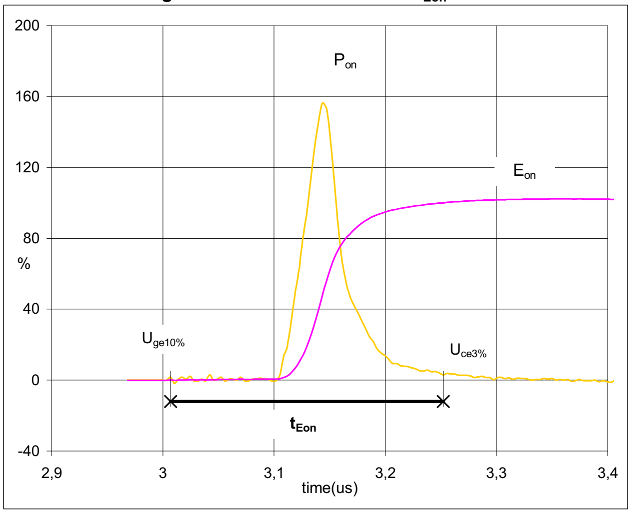
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	15,02	kW
E_{off} (100%) =	1,76	mJ
t_{Eoff} =	0,58	μs

Figure 6 Output inverter IGBT

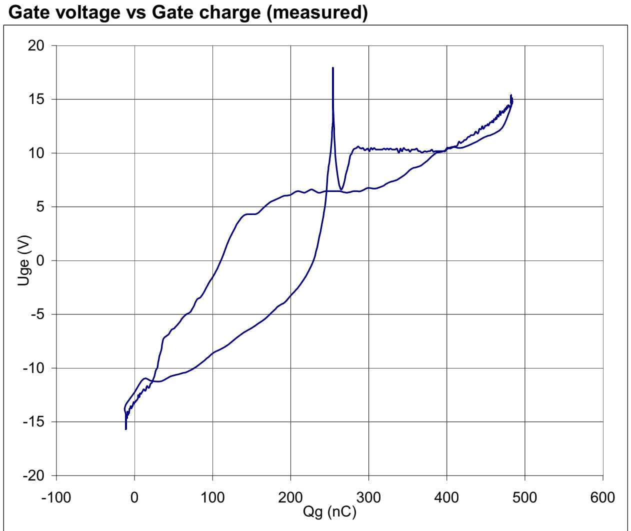
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	15,02	kW
E_{on} (100%) =	1,02	mJ
t_{Eon} =	0,24	μs

Figure 7 Output inverter FRED

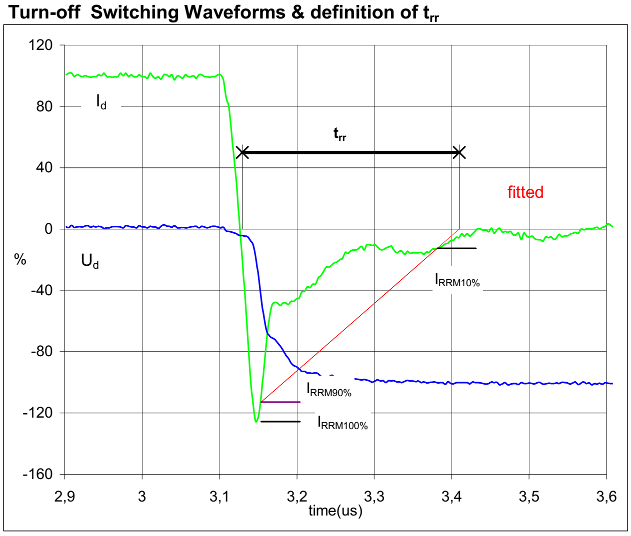
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	300	V
I_C (100%) =	50	A
Q_g =	3317	nC

Figure 8 Output inverter IGBT

Turn-off Switching Waveforms & definition of t_{rr}

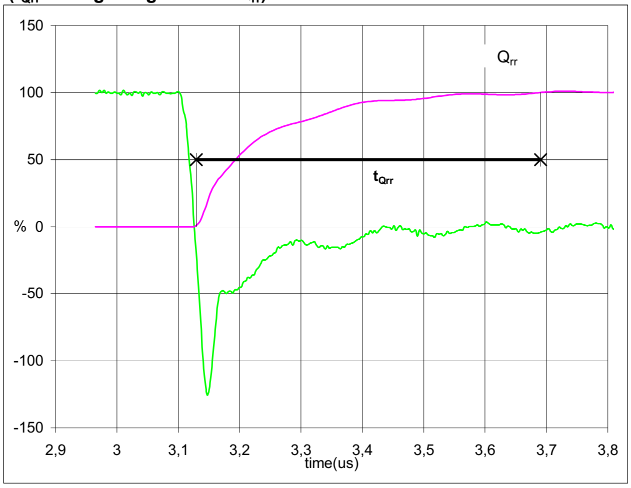


V_d (100%) =	300	V
I_d (100%) =	50	A
I_{RRM} (100%) =	-62	A
t_{rr} =	0,17	μs

Switching Definitions Output Inverter

Figure 9 Output inverter FRED

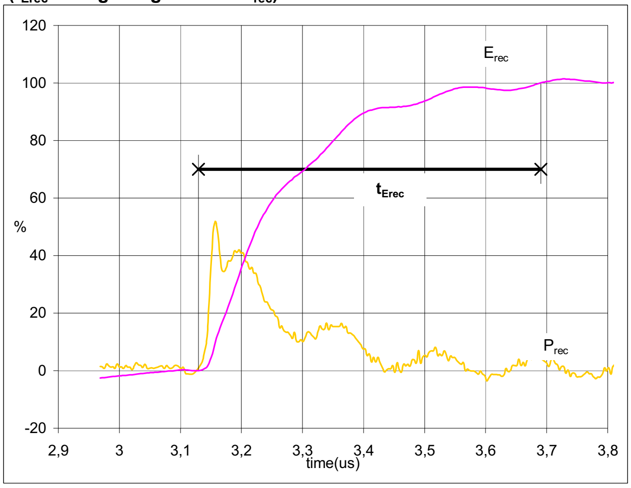
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	50	A
Q_{rr} (100%) =	4,37	μC
t_{Qrr} =	0,56	μs

Figure 10 Output inverter FRED

Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})

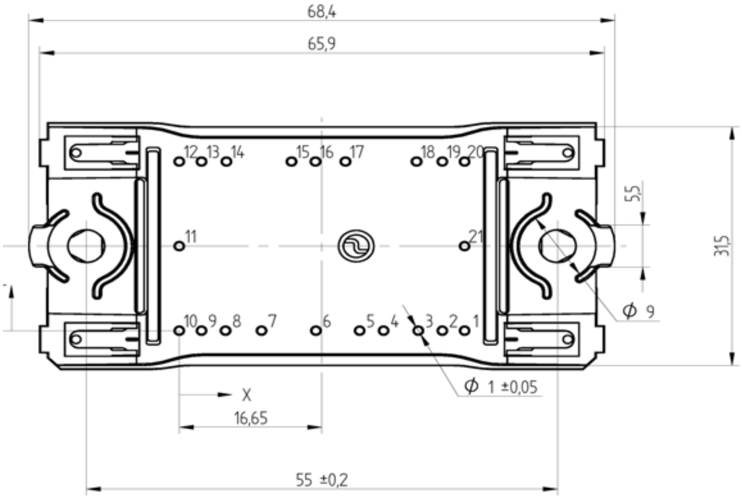


P_{rec} (100%) =	15,02	kW
E_{rec} (100%) =	0,92	mJ
t_{Erec} =	0,56	μs

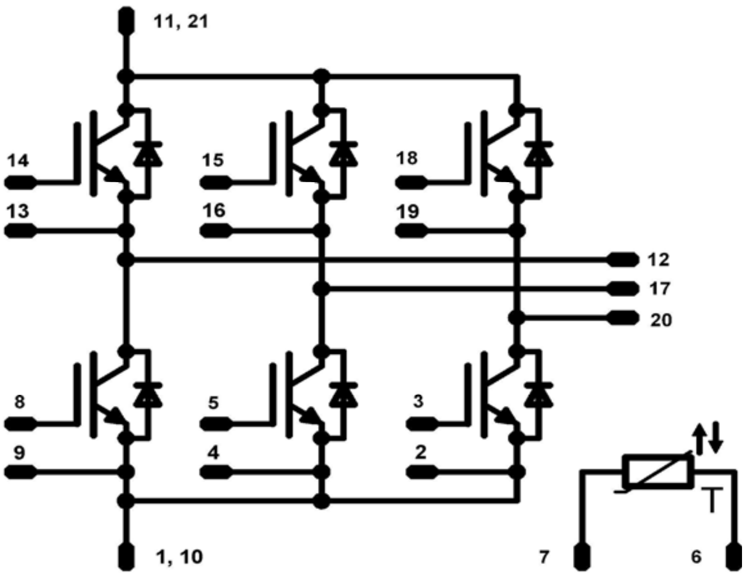
Package Outline and Pinout

Outline

Pin table		
Pin	X	Y
1	33,3	0
2	30,7	0
3	27,9	0
4	23,85	0
5	21,05	0
6	15,95	0
7	9,6	0
8	5,4	0
9	2,6	0
10	0	0
11	0	11,15
12	0	22,3
13	2,6	22,3
14	5,5	22,3
15	13,1	22,3
16	15,9	22,3
17	19,4	22,3
18	27,7	22,3
19	30,7	22,3
20	33,3	22,3
21	33,3	11,15



Pinout



PRODUCT STATUS DEFINITIONS

Datasheet Status	Product Status	Definition
Target	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. The data contained is exclusively intended for technically trained staff.
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